ALUMA FRAME SHORING SYSTEMS

Aluma Frame Shoring System (Aluma-Systems aluminum shoring) is approved for use up to a maximum height of 9 tiers. This system will be initially furnished by the Burke Company, a subsidiary of Aluma-Systems, on a rental basis.

This approval is based on the results of load tests for 22 foot maximum height towers, and on three dimensional computer modeling for higher tower configurations. Testing was performed on a plumb 3 tier high tower with various jack-head and extension-staff extensions. The results from the computer modeling were correlated to this test loading. The company's weaker braces were used in the test loading and for the computer modeling, but were not a factor in tower failure; tower failure was always by leg buckling. Leg buckling was found to be the most critical near the bottoms of the towers; therefore, jack extensions at the bottoms of towers should be kept to a minimum. As might be expected, maximum leg loadings decrease with increasing tower heights, principally because of constraints involving horizontal stability.

Falsework plans for Aluma-Systems aluminum shoring should include engineering data supplied from the manufacturer. Such data should include, as a minimum, two sheets approximately 24" x 36" numbered CALBR-01 AND CALBR-02, along with thirty 8 1/2" x 11" sheets dated DEC 92, titled "CALIFORNIA BRIDGE SHORING", numbered 1 of 30 through 30 of 30.

Tower leg load charts and other plan information apply specifically to 3 different tower height configurations: 1 to 3 tiers high, 4 to 6 tiers high, and 7 to 9 tiers high. The charts relate leg loadings to curves representing horizontal loadings for towers not adjacent to traffic. The Caltrans controlling horizontal load, along with a safety factor of 2.5 for the tower leg loadings is included in the load charts. For tower heights of less than 22 feet wind loadings do not control. Curves are included in the charts, for towers over three tiers high, which permit higher leg loadings if certain specific horizontal load restraints are furnished in the form of external bracing. External bracing in the direction of the cross bracing will always be required for towers over 6 tiers high.

The term H(s) is used in the charts to represent that portion of horizontal loads greater than the Caltrans controlling (wind or 2% of the dead load) horizontal load that may be applied to the towers above the soffit elevation. For Caltrans usage H(s) will normally be zero since the controlling wind or 2% of the dead loading is included in the curve plots.

A one-tier high tower consists of 2 end frames separated by pin end connection cross bracing on each. side of the frames. End frames are composed of extruded aluminum legs and fixed end connection type bracing. Cross braces may be Waco Shore-X of 1 inch round steel tubes which provide frame spacings of 4, 6, 8, and 10 feet; or Hi-Load cross braces of 1 l/4" x 1 l/4" steel angles which provide frame spacings of 4, 5, 7, and 10 f e e t .

Extension staffs are 3'- 10" long straight aluminum members which fit into tower legs and are held in place vertically with pins placed through holes in the legs and the extension staff. Extension staffs may be installed in tower legs at either the top or bottom of towers. Extension staffs, when used, constitute a tier in a tower makeup-

PERMITTED USE

Aluma-Systems aluminum falsework shoring towers may be used for all locations not adjacent to traffic provided the limitations for live load eccentricity, tower height, length of jack extensions (18 inches maximum) and extension staffs (25 inches maximum), maximum permitted leg loadings, and leg load ratios are not exceeded. External bracing may be required at the tops of towers more than 3 tiers high.

Jack extensions, to be used within the parameters shown on the various graphs, are measured between the end of the post or extension staff and the nearest side of the jack plate, as shown on sheet 5 of 30. Direct interpolation may be used between the 12" and 18" maximum jack extensions shown on the graphs.

All cross bracing within a tower composition shall have the same dimension between connecting holes so that all legs of the tow&s can be erected plumb.

Single tower legs may be bar-braced to tower end frames as depicted on plan sheet 11 of 30 provided additional bracing is installed in accordance with the included instructions.

<u>Towers up to 3 Tiers High</u>

For towers up to 3 tiers high, falsework plan sheets 5 of 30 and 6 of 30 relate safe working load per tower leg to the amount of jack extension.

Sheet 5 of 30 pertains to tower heights of 20 feet or less when extension staffs are not used, and jack extensions do not exceed l8 inches. When the shoring towers are to resist horizontal loads, the maximum leg loadings are 11.7 and 15.6

Kips for maximum jack extensions of 18 and 12 inches respectively. Slightly higher leg loads may be used if horizontal loads will not be transferred to the towers.

Sheet 6 of 30 pertains to tower heights of 22 feet or less where extension staffs may be used at both tops and bottoms of the towers. When the shoring towers are to resist the horizontal loads the maximum leg loadings are 7.5 Kips and 12.4 Kips for jack plus extension staff extending 43 inches and 25 inches maximum respectively. Slightly higher leg loadings may be used if horizontal loads will not be transferred to the towers.

Towers up to 9 Tiers High

When towers are to be erected more than 3 tiers high they are to be braced with diagonal and horizontal tube bracing into "Super Tower" configurations as depicted on sheet CALBR-02. A "Super Tower" is a group of towers arranged in a quadrilateral configuration with horizontal tubes installed so that they connect all towers at the tops of every third tier, and with diagonal tubes at the corner towers connecting every third tier in a zigzag pattern. When towers are to be spaced closer than 6 feet, and the tower height is to be more than 3 tiers, two adjacent towers must be laced together to form corner tower units. The tube bracing may be either steel or aluminum with properties as shown on sheet 26 of 30.

For towers up to 9 tiers high, falsework plan sheets 7 of 30 through 10 of 30 delineate permissible leg loads for towers in a "Super Tower" configuration. The graphs on these pages relate maximum leg loads of P(max) to leg load ratios of P(min)/P(max). The minimum to-maximum leg load ratios are important when considering the sequence and direction of placing concrete. In bridge work, for example, one or two tower legs can be heavily loaded during concrete placement while remaining legs support only the formwork and reinforcing.

Falsework plan sheets 7 of 30 and 8 of 30 pertain to towers up to 6 tiers high. External bracing will be required when leg loadings will exceed the loads provided for in the lowest curve (labeled "unrestrained") of the charts. This external bracing will need to resist specified horizontal loads, in addition to limiting lateral deflections at the tops of the towers to the amounts shown on the graphs.

The graphs on sheets 9 of 30 and 10 of 30 pertain to towers up to 9 tiers high. External bracing will be required for all leg loadings for tower heights exceeding 6 tiers. This external bracing will need to resist specified horizontal

loads, in addition to limiting lateral deflections at the tops of the towers to the amounts shown in the graphs.

An additional refinement for towers heights between 4 to 9 tiers is that external bracing will be required to limit lateral deflections at the tops of the towers to the amounts shown in the graphs.

Extension staffs are allowed at the tops of towers only for tower heights greater than 3 tiers. Extension staffs are considered to constitute a tier even though the maximum permitted extension is limited to 25 inches.

General

Elastic shortening of the aluminum posts must be included in net settlement considerations. The modulus of elasticity for the extruded aluminum alloy composition of the tower legs is approximately $10.2 \times l0^6$ psi.

Wind loadings on towers may be computed as outlined in Section 3-1.05A of the Falsework Manual. The shape factor for Aluma-System shoring shall be assumed as 2.2; which is the same as for heavy-duty shoring. The value to use for the projected area as defined in Figure 3-l of the falsework manual for two legs per face is 1.50 square feet per foot of tower height.

The maximum load on one leg of a tower, or on one end frame section of a tower, should not exceed four times the load on the opposite leg or frame under any given sequence of loading conditions.

The foundation design should be scrutinized to ensure that the vertical loads are uniformly distributed and differential settlements are minimized.

Additional or connecting members such as legs, external bracing, and aluminum stringers were not included in physical load testing or in computer modeling. Additional strap connected legs, if shown on the plans, may not be considered for use in the loading analysis.

Section 51-l.O6A(3), of the Standard Specifications permit only steel or wood posts adjacent to traffic openings, therefore Aluma-Systems aluminum shoring may not be used at these locations.

Aluma-Systems shoring will often be rental units with the tower falsework designed by the rental company's engineer who will then be responsible for compliance with the requirements of Section 1717 in the Cal/OSHA Construction Safety Orders.

Aluma-Systems aluminum shoring components will generally be identifiable by paste on stickers or by alpha-numeric stamped impressions.

A list of current distribution centers for Aluma-Systems Shoring is included below:

ENGINEERING AND DISTRIBUTION CENTERS OF THE BURKE COMPANY

Livermore, CA 94550
5340 Brisa Court l
(714) 556 3900

Fountain Valley. CA 92708
11140 Talbert Ave.
(714) 556 4510

Sacramento, CA 95815
1730 Lathrop Way
(916) 920 4343

DISTRIBUTION CENTERS ONLY OF THE BURKE COMPANY

Fresno, CA 93711
313 West Falbrook Ave.
(209) 276 2415

Milpitas, CA 95035
1550 Gladding Court
(408) 262 9100

Montebello, CA 90640
1625 West Washington Blvd.
(213) 724 6690

Oakland, CA 94607
310 Union Street
(415) 465 3900

San Diego, CA 92102
4937 Market Street
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